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ABSTRACT

This report describes a program for increasing the thinking skills of fourth grade students in one classroom in northern Illinois. Both objective and subjective data gathering found that students experienced difficulty in relating and applying facts and concepts on tasks requiring more sophisticated thinking. Solution strategies combined with an analysis of the problem setting resulted in the selection of three major intervention categories: strategies to increase student ownership of learning and self-assessment, strategies to increase metacognitive abilities, and strategies to build hierarchical thinking. The strategies included keeping journals by both students and teacher, using graphic organizers, and infusing the three-story intellect model and hierarchical questioning into the fourth grade curriculum. Students' use of higher-level thinking increased as projected. Students showed competence to self-assess, exhibited ownership of learning, and articulated problem-solving processes. (EH)

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ENHANCING THE THINKING SKILLS OF FOURTH GRADE STUDENTS

BY

PAMELA WADE

MAY 1994

FIELD BASED MASTER'S PROJECT

ST. XAVIER UNIVERSITY
SCHOOL OF EDUCATION

SO 027 991

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Dean, School of Education

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Abstract

Pamela Wade Rockford II
May 1994

Enhancing The Thinking Skills of Fourth Grade Students

This report describes a program for increasing the thinking skills of fourth grade students, in a rapidly growing rural community, located in northern Illinois. The problem was noted by the teacher, who found through tests and observations, that students experienced difficulty in relating and applying facts and concepts on tasks requiring more sophisticated thinking.

Analysis of the probable cause data revealed that the development of problem solving, reasoning, conceptualization, and analysis are not generally emphasized in most classrooms. The standard curriculum lends itself to the basic thinking skills of recall, recite, and describe.

Solution strategies suggested by knowledgeable others, combined with an analysis of the problem setting, resulted in the selection of three major categories of intervention: strategies to increase student ownership of learning and self-assessment; strategies to increase metacognitive abilities; and strategies to build heirarchical thinking.

Students' use of higher-level thinking was increased as projected. Students evidenced competence to: self-assess, exhibit ownership of learning, and articulate problem-solving processes.

Chapter 1

STATEMENT OF PROBLEM AND DESCRIPTION OF CONTEXT

Problem Statement

The fourth grade class at Poplar Grove Elementary School exhibits an inability to relate and apply facts and concepts on tasks requiring more sophisticated thinking, such as inferential reading, persuasive writing, interpretation of data, and multistep problem solving. Measurements indicating this inability include teacher-made assessments, the Illinois Goal Assessment Program, and the Iowa Test of Basic Skills.

Description of Immediate Problem Setting

The population of Poplar Grove Elementary School consists of 236 kindergarten through eighth grade students. This elementary school is one of three kindergarten through eighth grade buildings in the district. All of the elementary buildings feed into one high school. The student population of the targeted elementary school is 97 percent White, 1.7 percent Hispanic, .4 percent Black, and .9 percent Asian or Pacific Islander. Twenty students in the school are classified as learning disabled, one student is classified as behavioral disordered, all of these students are mainstreamed to varying degrees; four

students attend self-contained classrooms for severely handicapped at a separate building in cooperation with a neighboring school district; two students attend a handicapped accessible building within the district; thirty-three students receive remedial reading instruction daily; six students attend speech and language improvement classes twice a week; and one student receives assistance for a hearing-impairement twice a week.

Family socio-economic status covers a wide range, with seven percent of the school's families being supported by public funds, and the majority of the families in the middle income levels. More than half of the students come from two-income homes. The attendance rate is 96 percent, and the student mobility rate is a relatively low 11.4 percent. There is one student classified as a chronic truant.

The staff of the school includes; one principal, nine grade level teachers, one learning disability teacher, one remedial reading teacher, two part-time physical education teachers, one part-time music teacher for grades six, seven, and eight, one part-time art teacher for grades six, seven, and eight, one library aide, one part-time media specialist, one part-time nurse, one part-time speech and language specialist, one part-time hearing-impaired specialist, and four classroom teaching aides. Auxiliary personnel

include one secretary, two cooks, and two janitors. A school psychologist is available upon request through a two-district special education cooperative. The school personnel are 100 percent white and 83 percent female.

Description of Surrounding Community

Poplar Grove Elementary School is a part of the North Boone Community Unit School District, and is located in a rural area. The district has a student population of 1,036. The community is located 90 miles northwest of Chicago, Illinois and 60 miles south of Madison, Wisconsin. The North Boone Community Unit School District is in the northern part of Boone County; a larger school district is located in the southern part of the county. The county has a total population of 48,284. The decade of the 80s saw a population increase of ten percent. From April 1990, to August 1992, the county experienced an additional twelve percent increase. The present rate of growth will yield a 32 percent increase from 1990 to the turn of the century. Since 1988, the yearly residential construction activity has increased 123 percent in the county. Since 1988, the county has approved thirty-four residential subdivisions totaling 675 lots. As of August 31, 1992, two-hundred and fourteen dwelling units have been completed within the thirty-four subdivisions. A surplus of 461 lots remain

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for development. Commercially, two malls are being developed and one existing mall is undergoing extensive rehabilitation. Two new industries have moved into the county in 1992, and Chrysler Motors has built a new stamping plant in this county to be completed in 1993. This level of growth has contributed to over-crowded classrooms and financial despair for the school district.

An investigation into the educational characteristics of the adult population revealed that 40 percent are high school graduates, 25 percent have not graduated from high school, eighteen percent have some college hours, and seventeen percent have a college associate or higher degree.

The socio-economic status of the county, as reflected by the 1990 census, shows that the median family income is $38,586, and the per capita income is $14,355. Almost fifty percent of the people who live in the county, work in the county.

The county's population is 95 percent white, and six percent hispanic. Of the people moving into the county, 45 percent are from Chicago and suburbs, thirty-one percent are from other areas in Illinois, and the rest move in from out of state.

Regional and National Context of the Problem

Enhancing the thinking skills of today's students to a more sophisticated level is a problem that is

addressed not only by educators, but by society itself in seeking to qualify today's youth for tomorrow's world. The Association for Supervision and Curriculum Development (ASCD, 1984 p. 4) has acknowledged the need for an expanded version of the basics in a resolution: "Further development and emphases are needed in teaching skills of problem solving, reasoning, conceptualization, and analysis, which are among the neglected basics needed in tomorrow's society." In its analysis of trends in reading achievement, the United States Office of Educational Research and Improvement concluded that "while it appears that progress has been made in raising the share of students who acquire rudimentary, basic and intermediate reading skills and strategies, no gains are evident at the higher levels of reading ability" (Mullis and Jenkins, 1990, p. 35). This pattern is confirmed by the results of the most recent National Assessment of Educational Progress in reading: "Students at all three grade levels (3, 7 and 11) have particular difficulty with tasks that require them to elaborate upon or defend their evaluations and interpretations of what they have read. Continued attention to such skills must be a major priority in instruction" (Applebee, Langer, and Mullis, 1988, p. 6). The Nation's Report Card states:

> The mathematical performance of students at ages 9, 13, and 17 has improved somewhat over the past eight years, yet a closer look at levels of proficiency indicates that most of the progress has occurred in the domain of lower-order skills. This picture reflects classrooms more concerned with students' rote use of procedures that with their understanding of concepts and developments of higher-order thinking skills. (Dossey, Mullis, Lindquist, and Chambers, 1988, p. 12).

> The recent improvements occurred only in lower-level skills and basic knowledge. While average science proficiency is on the rise, students in the upper range of science proficiency did not show any improvement--nor are there increasing percentages of these students. Performance on moderately complex and specialized scientific tasks has not changed in almost a decade, and only a small number of students, merely 7 percent of 17-year-olds-- demonstrate such higher-level skills. (Mullis and Jenkins, 1988, pp. 19-20).

> In both 1984 and 1988, a majority of the students at all three grade levels were able to write at least minimal responses to most of the persuasive tasks. Far fewer students, however, wrote at the adequate level, which required supporting points of view with evidence and reasoning. (Applebee, Langer, Mullis, and Jenkins, 1990, p. 40).

From a very early age, children in our society are conditioned to be unquestioningly obedient to adult directives. Usually students continue this pattern of behavior in school. It is more uncommon than common for students to question reasons for performing a particular task. Metacognition is virtually an unknown in students' school experiences; it is neither sought after by the student nor encouraged by instruction (Sternberg and Wagner, 1982). Beyond recall and

recite, educational outcomes should include the intelligent behaviors associated with higher-order thinking. Teaching methods, staff development and supervisory techniques must be assessed and changed, where appropriate, if the childrens' higher level thinking processes are to be developed (Costa, 1981).

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Chapter 2

PROBLEM EVIDENCE AND PROBABLE CAUSE

Problem Background

The accumulation of facts to recall, recite, and describe has become obsolete in educating students for their life and work (Costa, 1981). In The Future World of Work, The United Way of America (1988) predicts that "the greatest job growth over the remainder of the century will occur in areas that require high skill levels and demand creative thinking (p. 2)." The National Science Board Commission on Pre-College Education in Mathematics, Science, and Technology (1983) declared in its report, Educating Americans for the 21st Century:

> We must return to basics, but the basics of the 21st century are not only reading, writing, and arithmetic. They include communication and higher problem-solving skills, and scientific and technological literacy--the thinking tools that allow us to understand the technological world around us...Development of students' capabilities for problem-solving and critical thinking in all areas of learning is presented as a fundamental goal(p. 3).

The rapid increase of available knowledge has particular significance for education. Content teachers frequently lament their inability to cover all the material in the content curriculums. The increased knowledge bases of many subjects quantitatively compound the task. It is clear that a strategy is needed that emphasizes developing the lifelong learning and thinking skills necessary to acquire and process information within an ever-expanding field of knowledge. In the institute brochure for the Study of Human Knowledge, Robert Ornstein (1980) stated, "We need a break-through in the quality of thinking employed both by decision-makers at all levels of society and by each of us in our daily affairs."

Locally, there has been a tacit assumption that students were developing sophisticated thinking skills from the relatively traditional approach to instruction, relying heavily on classroom presentations, textbooks, and workbook or teacher-prepared exercises. These techniques lend themselves to assisting students attainment of basic levels of proficiency in each subject area; however, they have not proven to help students achieve higher levels of performance. The district's superintendent

formed a Vision Committee, made up of parents, Board of Education members, principals, and lead teachers representing each of the four buildings in the district. The committee's purpose is to determine the goals of instruction that need to be considered to better prepare students for their future. The superintendent, heading the committee, began by including the committee in development programs such as paradigms of education, brainstorming student needs for tomorrow's life and work, and alternative assessment procedures.

Problem Evidence

Both subjective and objective means were used to document student need for more sophisticated thinking skills. A questionnaire was given to the principal. (Appendix A) Using narrative classroom observations, the principal tallied the number of teachers in the building who, through the normal course of instruction were observed: using questioning techniques to promote higher-level thinking, using and labeling specific problem-solving strategies, encouraging metacognition,, applying and labeling cognitive strategies for the students, and creating a classroom climate for thinking

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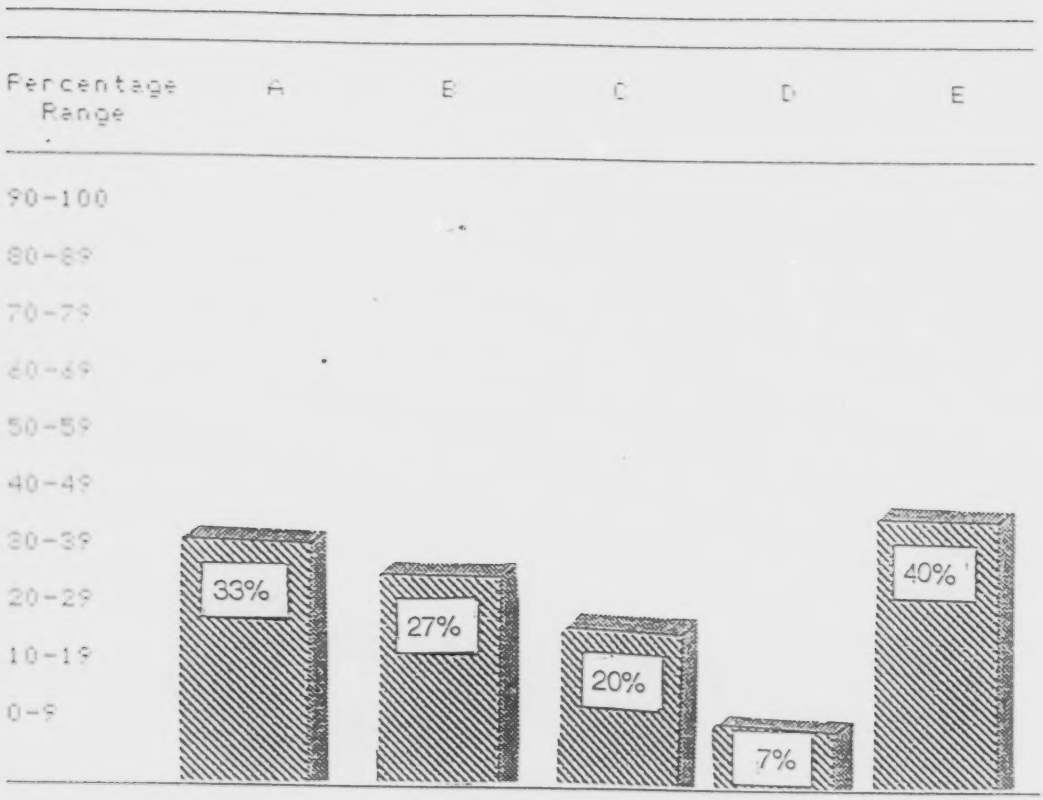
by using a comprehensively nondiscriminatory tone during discussions.

Figure 1 presents data on the percentage of staff infusing thinking skill instruction into the curriculum. The data indicate less than half of the staff infuse higher-level thinking skills into the curriculum on a regular basis. Five broad categories of thinking skill infusion were considered. Column A indicates that thirty-three percent of the staff ask questions that require analysis, synthesis, and conceptualization. Twenty-seven percent of the staff identify and label specific problem-solving strategies such as graphic organizers. Metacognition is used by twenty percent of the staff as indicated in Column C. The table reveals the fewest number of staff, seven percent, verbalize cognitive strategies and their application to problem solving within the curriculum. Forty percent of the staff create a classroom climate for thinking by using an acceptant tone during discussions. A summary of these data reveals room for growth in infusing thinking skills by this staff.

A survey was administered to all faculty at this school. (Appendix B) A summary of these data indicates that forty-seven percent of the staff engage



A = Asks questions that demand "why" and "how" responses.

B = Identifies specific strategies to students used in solving problems and labeling those strategies.

C = Reflects with students explicitly on the the cognitive processes used to solve a problem.

D = In the context of regular subject matter, reminds students of cognitive strategies which can be applied.

E = Creates a classroom climate for thinking by using an acceptant tone during discussions.

Figure 1

The Percentage of Staff Infusing Thinking Skills in Their Curriculum

in teaching thinking skills, but sixty percent of the staff do not have provisions for evaluating the learning of thinking skills. Seventy-four percent of the staff relate that the school system does not have guidelines for thinking skills across the grade levels or subjects. In addition, sixty-four percent of the staff perceives that supervisors and instructional leaders do not create conditions for thinking skill development through inservicing, modeling, or providing time to establish school-wide continuity of infusing thinking skills in the curriculum. The results can be perceived as contradictory indicating: a lack of a common definition of teaching thinking skills; a lack of continuity in teaching thinking skills; a lack of established goals for instruction as to the attitude, skill, and knowledge components of thinking; and a lack of employment of direct, systematic instruction of these skills prior to, during, and following student introduction to and use of these skills in the classrooms.

Teacher observations, and oral and written records of student responses were collected as problem evidence. A parent survey for each child and a teacher survey for each child was administered in September of

1993 to further document thinking skill levels of the students. (Appendix C) The summarized parent survey indicated that: 17 percent of the class are not yet using the home thinking behaviors indicated on the survey, 46 percent of the class sometimes demonstrate the home thinking behaviors, and 37 percent of the class frequently demonstrate the home thinking behaviors. The summarized teacher survey data indicated that: 47 percent of the class are not yet engaging, at school, in the thinking behaviors indicated on the survey, 40 percent sometimes show school thinking behaviors, and 15 percent frequently exhibit the behaviors on the teacher survey. There are several factors that contribute to the discrepancy in the surveys. For example, the objectivity factor in parent/child relationships and teacher/student relationships is a possibility, home and school environmental differences may exist, survey statement perception can be operative, and parent/teacher expectation may be different. In light of the discrepancies, the surveys indicated a need for thinking skill growth specifically in the areas of stating several ways to solve a problem, putting into words how a problem is solved, reflecting on what has

been done, and using prior knowledge in new situations. Figure 2 reflects the compiled survey data.

Data was also collected from students' Iowa Test of Basic Skills scores and from students' Illinois Goal Assessment Program scores. The fourth grade class took the Iowa Test of Basic Skills in April of 1993. The basic composite results revealed that this class has more high and average achieving pupils and fewer low achieving pupils than do other schools. Conclusions of the average complete composite showed the composite grade equivalent for this third grade class, was fourth grade, third month. Compared with the national distribution of pupil scores, the typical pupil in this class scored as well or better than 66 percent of grade three pupils in the country.

In the spring of 1993, the Illinois Goal Assessment Program (IGAP) for writing, math, and reading was administered to the class. Their average scaled score for Constructing Meaning was 275. The Constructing Meaning score reflects the students' ability to comprehend written material, to draw inferences, and to apply information from the text. The Illinois Goal Assessment Constructing Meaning scale score is a standard score that ranges from 0 to 500

Parent Survey Results Teacher Survey Results

Due to rounding error, the total may not equal 100%.

Not Yet = Child/student is not yet engaging in thinking skill behaviors.
Sometimes = Child/student is sometimes engaging in thinking skill behaviors.
Frequently= Child/student frequently engages in thinking skill behaviors.

Figure 2

Percentage of Children Engaging in Thinking Skill Behaviors as per Survey of Parents and Teachers; September 1993.

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with an average of 245 for all third grade students who took IGAP in 1993. Their Overall Writing average scale score was 16.9. Overall Writing scores are expressed on a scale that ranges from 6 to 32 with an average of 17.7 for all third grade students who took IGAP in 1993. This assessment requires students to write a paper demonstrating the basic fundamentals of clear writing. The papers are evaluated with respect to focus, support, organization, and integration. The students' overall math scaled score was 274. Scores are based on number concepts, measurement, algebra concepts, geometry concepts, data collection, and estimation. The IGAP Mathematics score is a standard score that ranges from 0 to 500 with an average of 268 for all third grade students who took IGAP in 1993.

Since the ITBS and the IGAP measure basic skills, at the recall level, these test scores reflect that the majority of the class is average to above average in achievement on basic recall assessments.

Probable Causes of Problem

Data to indicate probable cause factors were gathered from a number of sources within the setting. Initially, an evaluation of the fourth grade curriculum was undertaken. The results of this review showed

textbook content to be structured toward the unquestioning acceptance of claims, an enormous amount of drill, easily scored assessments, and most generally an advocation of single solutions.

Another probable cause is the lack of teacher development and emphasis in teaching the skills of problem solving, reasoning, conceptualization, analysis, and the use of hierarchical questioning. There is an emphasis on standardized test scores, which tend to discourage perseverance of problem solving and thinking critically, flexibly, and insightfully.

Another contribution to the cause of the problem is increased class size and more difficult-to-manage students resulting in teachers being overly structured. Highly structured busywork replaces discussion which can be potentially disruptive. Classroom control can take precedence over innovative teaching (Janko, 1989).

The inappropriate media presentations to which students are subjected create a probable cause associated with lack of higher level thinking skills. The popular television talk shows -- the ones that students generally watch -- frequently exploit issues rather than explore them. Television news programs routinely reduce all issues to 30-second clips in which

two or three authorities or political leaders sum up their opinions. These clips rarely resemble thoughtful, analyzed, or articulated positions. The average child born today will, by the age 15, have spent more time watching television than going to school (Liebert, 1986).

Probable cause data from the literature was categorized into deficiencies related to curriculum goals, curriculum content, instructional methods, and assessment procedures. According to Doyle's (1983) study of academic work in American schools, accountability and testing drive schooling. Students learn early in the game that all classroom activities are not equal; some things are tested, and others are not. By the time students have reached high school, they know the rule well: "Learn what will be tested." The result, despite teachers' good intentions, is devaluation of independent thought. The most widely publicized study of this problem was conducted by John Goodlad (1984) and reported in his book A Place Called School. This exhaustive study of American education involved observations of more than 1,000 classrooms in a variety of communities throughout the country. A summary of results showed that an average of 75 percent

of class time was spent on instruction. Approximately 70 percent of this time involved verbal interaction -- with teachers "out talking" students by a ratio of three to one. Observers noted that less than 1 percent of this "teacher talk" invited students to engage in anything more than mere recall of information (Goodlad 1983).

A summary of probable causes for the problem gathered from the sight, and from literature included the following elements:

1. Development and emphasis are needed in teaching skills of problem solving, reasoning, conceptualization, and analysis.
2. Most curriculum is structured toward the unquestioned acceptance of claims.
3. Most curriculum is structured toward drill, easily scored assessments, and single solutions.
4. There is an emphasis on standardized test scores.
5. There are increased class sizes.
6. Students are more difficult to manage.
7. There is inappropriate modeling by the influential media in its approach to subjects, and discussions of them.

Chapter 2

THE SOLUTION STRATEGY

Review of the Literature

Analysis of probable cause data suggested reasons related to a lack of emphasis on the development of problem solving, reasoning, conceptualization, and analysis at the instructional level; unsatisfactory ability of students to initiate ownership of their learning and poor employment of higher-level thinking skills; and curriculum geared toward recall, recite, and describe. In addition to these data, research literature suggest the following possible causes: inappropriate assessment methods normally used in classrooms, curriculum not preparing students for 21st century life and work, low levels of staff knowledge relative to the teaching of higher-level thinking skills, and lack of appropriate modeling of higher-level thinking skills in the students' world.

The literature search for solution strategies was organized as suggested by these probable cause data.

Analysis of these data suggested that a series of questions related to instructional strategies, student empowerment of their thinking skills, curricular design, and extraneous factors affecting students' sophisticated thinking should be addressed.

The questions related to instructional strategies included: 1) How is higher-level thinking defined? 2) What are the goals of embedding higher-level thinking skills in the classroom? 3) What teacher behaviors encourage higher-level thinking? 4) What are the training implications for teachers, administrators, schools, and districts?

The questions related to the learner were: 1) What factors promote ownership of learning? 2) How can students more effectively apply knowledge? 3) How can students adapt skills and concepts to unrelated areas?

Curriculum design questions included: 1) What curriculums expect, stimulate, or provide contexts for higher-level thinking? 2) How will new technologies be used to enhance higher-level thinking? 3) Will competency be addressed through generation of knowledge by the student, reproduction of knowledge by the student, or a multifaceted approach?

The questions related to extraneous factors affecting student thinking were: 1) What kind of modeling of higher-level thinking skills is available to children from parents, teachers, significant adults in their lives, and the media? 2) Do out-of-school activities promote higher-level thinking for students?

These questions suggested that appropriate categories for the literature search should include: teaching for thinking, teaching strategies that enable student thinking, curriculum design, assessment techniques, and environmental impact on students' higher-level thinking.

Research seems to indicate that if fundamental change is to occur in enhancing students' ability to think, teachers require more intense, ongoing technical assistance (Fulton, 1985; McLaughlin and Marsh, 1978; Stevenson, 1987).

In a study by Onosko and Stevenson (1987), five effective strategies for promoting higher-order thinking were identified:

1. Help teachers analyze and develop a conceptualization of thinking. By working toward an articulated conception of thinking, teachers can be stimulated to reconsider their instructional goals.

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For example, an understanding of the characteristics and dispositions of good thinkers can move teachers from a rigid emphasis on content acquisition to a more balanced approach that acknowledges the importance of thinking processes and skills. In addition, the conceptualization that emerges provides a common language for teachers to discuss their efforts with colleagues.

2. Model specific instructional strategies for promoting student thinking. Modeling instructional strategies (whether in workshops, on videotape, or in teachers' classrooms) enables teachers to see specific alternatives to traditional methods such as lecture and recitation. When strategies are demonstrated with students (especially the teacher's own), teachers gain confidence not only in the specific strategies used, but also in their students' ability to engage in higher-order thinking.

3. Provide opportunities for teachers to practice and discuss instructional strategies. Demonstrating and discussing lesson presentations among peers allows teachers to receive constructive feedback and recognition. Demonstrations can take place in teachers' own classrooms or in workshops where fellow

participants role-play students, or teachers can bring videotapes of their classroom teaching to workshop sessions. Given the traditional isolation and lack of adult interaction present in teachers' work settings, these opportunities are important for fostering collegiality and commitment to a common goal.

4. Provide time for teachers to discuss workshop ideas and techniques and to formulate classroom applications. Discussion time enables participants to review newly introduced ideas and techniques, brainstorm applications to their own classrooms, and later share their experiences in trying out the ideas and techniques in their own classrooms. Dialogue and reflection are essential if teachers are to successfully incorporate new ideas into their own practices.

5. Engage teachers in higher-order thinking, such as authentic problem solving, in their subject areas. Encourage teachers to reflect on and analyze their own thinking in trying to solve a challenging problem, either individually or in small groups. Such problems might include mental puzzles, controversial public issues, or simulated decision-making exercises. The intent is to stimulate teachers' enthusiasm for

thinking as an instructional goal, develop self-confidence in their own ability to think, and help them become more conscious of the kinds of thinking they wish to promote.

Solution possibilities for strategies to enhance thinking skills were addressed by the literature. Cooperative learning in a classroom is a strategy heralded by many knowledgeable others relative to building more sophisticated thinking skills. Cooperative learning may be broadly defined as any learning activity in which students of diverse backgrounds work together in groups toward a specific goal. Considerable research conducted in recent years substantiates the effectiveness of cooperative learning methods for promoting increased student achievement, improved attitudes toward school, and enhanced interpersonal relations (Johnson, Maruyama, Johnson, Nelson, and Skon, 1981; Slavin, 1981). Cooperative learning promotes the interactive processing of ideas and thus naturally complements other instructional approaches for developing student thinking skills. This natural fit is recognized by the educational researchers Joyce, Showers, and Rolheiser-Bennett (1987), who note that research into cooperative

learning is overwhelmingly positive and the cooperative approaches are appropriate for all curriculum areas. The more complex the outcomes (higher-order processing of information, problem solving, social skills and attitudes) the greater are the effects. A number of cooperative learning designs are especially well suited to stimulating higher-order thought. These designs include peer response groups for writing, group problem solving in mathematics, reciprocal teaching in reading, group investigations and experiments in science, discussions and debates using structured controversies in social studies and home economics, and collaborative projects in any content area (Joyce, et al., 1987). Parker (1984) found that small-group cooperative learning emphasized the development of thinking and problem-solving skills. One advantage of this approach to teaching is that it seeks to minimize student anxiety and competition by creating an environment where students feel safe to make and learn from mistakes. Also, Gilbert-Macmillan (1983) suggests that another advantage of cooperative learning groups is that they give students an opportunity to talk aloud, challenge and defend a point of view, and focus on the problem-solving process rather than the answer.

Rowe (1973) stated that the teacher must establish an environment which promotes and allows for active inquiry. A well-conceived question, presented in a timely manner, is a useful means to clarify and expand thinking (Sund and Carin, 1978). Teacher questions are the means used to communicate the elements of the subject matter. They provide guidance about what is to be done with information and how it is to be done (Hunkins, 1976). In a review of research on questioning, Gall (1984) reported that 80 percent of the questions used in classrooms asked students to do something other than think. The heavy emphasis on rote memory is well documented in the research for all instructional levels. A useful graphic (Appendix D) from the words of Oliver Wendell Holmes that aptly categorizes the type of questioning techniques needed to enhance higher level thinking. Holmes's 'Three Story Intellect' is as follows:

> There are one-story intellects, two-story intellects and three-story intellects with skylights. All fact collectors who have no aim beyond their facts are one-story men. Two-story men compare, reason, generalize, using the labor of fact collectors as their own. Three-story men idealize, imagine, predict -- their best illumination comes from above the skylight (p. 300).

Another solution strategy that is part of the art of questioning is for teachers to allow for 'wait time' after asking a question. Teachers can become more productive inquirers by extending their pauses after asking questions and receiving responses from students. As wait time is extended, research shows that the quantity and quality of students' responses increase (Rowe, 1987).

A solution strategy advocated by the literature to enhance thinking skills was the use of graphic organizers. Important ideas and relationships often go unseen by students because verbal tools alone do not clearly communicate overall patterns of how people are thinking. Hyerle (1989) suggests that connected graphic representations can supplement the use of verbal and numeric symbols for communicating thinking in the classroom. Students can learn how to visually represent and connect information in linear, holistic, and analogical patterns. Students then have the additional tools for reflecting on the pathways of their thinking and for improving their thinking abilities. Graphic organizers also enable teachers to see and assess students' maps of prior knowledge, to present new content information in connected ways, and

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to evaluate students' content learning by seeing the development of students' thinking over the course of instruction. Graphic organizers demonstrate success in improving the retention, organization, and assimilation of concepts and ideas. They provide a deliberate technique for allowing students to interact personally with the information and to make the thinking visible for both the students and the teacher (Hyerle, 1989).

Metacogntion -- thinking about thinking -- as Costa (1990) suggests is an integral strategy for building thinking skills. He states that planning, monitoring and evaluating the learning activity are the components of metacognitive processing. Mrs. Potter's Questions (Bellanca and Fogarty, 1989) (Appendix E) are examples of metacognitive questions that promote reflective thinking and foster future applications.

Another strategy for enhancing thinking skills involves using writing and thinking as mutually supportive activities. Definite connections between writing and thinking are found by Olson (1984). In her work the six levels of Bloom's classic taxonomy -- knowledge, comprehension, application, analysis, synthesis, and evaluation -- are related to the stages of process-based writing -- prewriting, writing,

rewriting, revising, and editing. Olson contends that while students frequently do not have classroom opportunities to engage in the top three levels of Bloom's taxonomy, writing offers numerous opportunities for students to engage in analysis, synthesis, and evaluation. Fogarty (1990) stated that a thinking log is much like a footprint. Both are uniquely personal impressions that mark one moment in time. Yet, whereas the footprint may disappear with the wind, the thinking log cements the thought-filled page for all time. Emig (1978) and Britton (1972) believe we learn to think by writing. Carnegie Foundation President Ernest Boyer (1983) advocates teaching writing across the curriculum because "clear writing leads to clear thinking; clear thinking is the basis of clear writing." Perhaps more than "any other form of communication," he adds, "writing holds us responsible for our words and ultimately makes us more thoughtful human beings."

Solution strategy possibilities related to curriculum design emphasize the transfer of developing thinking skills across subject lines and relating problem solving techniques to experiences encountered throughout the day. Extensive research, conducted largely at The Center for the Study of Reading at the

University of Illinois at Urbana, suggests that existing commercial materials often hinder comprehension because they lack appropriate connectives, pronoun references, and highlighting and signaling devices that help students understand the text (Anderson and Armbruster, 1984; Osborn, Jones, and Stein, 1985). Research on text design emphasizes features to heighten thinking skills:

Before reading -- use review, preview, titles, subtitles, and paragraph headings;

During reading -- use underlining, boldfacing, italics, boxes, and marginal notes;

After reading -- use summaries and graphic organizers.

The previous citations from the literature suggest that the most powerful factor in curriculum design is the role of the teacher. According to the Commission on Reading (1985), the effects of the teacher are far more significant than the effects of instructional materials, curriculum alignment, and other variables. Specifically, the teacher is important as a manager of instruction with the ability to make effective decisions about content, pacing, grouping, and use of time (Berliner, 1984). Equally important, the teacher

is a mediator of learning, providing instruction that is explicit, sustained, and interactive, guiding the students to construct meaning from text.

The literature search included assessment strategy possibilities to measure more sophisticated thinking. Thomas (1980) and many others have shown that how you teach is what you get. When teachers decide for students what, how, and when they should learn, and when the reward system is external, students excel on standardized tests but perform poorly on tasks of reasoning, creativity, and internal locus of control. On the other hand, when teachers give students the responsibility for deciding what to learn, how to learn it, and how to evaluate their own growth in that learning, and when the reward system is internal to the task, students excel in problem solving, creativity, and internal locus of control but perform less well on low-level achievement tests. Costa (1991) stated that data systematically collected over time through direct observation of performance are probably more reliable than data collected on a standardized achievement test composed by someone unfamiliar with the curriculum, the teacher's goals, the learning opportunities, or students' cultural/home backgrounds. He suggests three

methods for collecting evidence of students' intellectual growth: 1) The HOW ARE WE DOING checklists (Appendix F), developed by Bena Kallick (1988); 2) A Reporting Form for Parents (Appendix G), developed by Charlotte Palmer (1988); and 3) A sample letter for gathering feedback from parents (Appendix H). In addition to these, Wiggins (1989) suggests student portfolios and journals, teacher journals, video or audio recordings, and/or student interviews. When collected systematically over time, all can be analyzed for: quality of questions and discussion, relating and applying facts and concepts, reasoning, conceptualizing, analyzing, synthesizing, and metacognating.

Literature purports modeling to be a solution strategy for developing sophisticated thinking skills. Bandura (1986) notes that learning cognitive skills can be facilitated simply by having models verbalize their thought strategies aloud as they engage in problem solving activities. A considerable number of studies conclude that students adopt new behavior patterns or modify their own behavior on the basis of observation alone. Thus, since there is such an extended contact between teacher and student, the teacher is one of the

most significant and influential models in a student's life. Modeling tends to reinforce students' perceptions of the values and goals stated by the teacher or by the school. By exhibiting the kinds of behaviors desired in students, adults can strongly influence students' behavior patterns (Costa, 1991).

Project Outcomes

The terminal objective of this problem intervention was related to the discrepancy data presented in Chapter 2: teacher direct observations; oral and written records from the students; principal, parent, and teacher surveys; and test scores. These collections indicated an inability of the fourth grade students to relate and apply facts and concepts on tasks requiring more sophisticated thinking. Probable cause data, presented in Chapter 2, and solution strategies presented in this chapter suggested the need for: teacher development with an emphasis on teaching for thinking, instructional strategies, curriculum design, suitable assessment techniques, and appropriate modeling of desired student behaviors.

Therefore:

> As a result of instructional strategies purposefully intended to develop children's cognitive abilities being integrated into

the curriculum, beginning in September of 1993 to January of 1994, the fourth grade students will increase their thinking skill level as measured by survey data which will be administered in September of 1993, and January of 1994, student journal entry comparisons from September of 1993 to January of 1994, teacher written observations from September of 1993 to January of 1994, and student interviews which will be conducted in September of 1993 and January of 1994.

In order to accomplish the terminal objective, the following intermediate objectives defined the major strategic procedures proposed for problem resolution.

1) To develop children's cognitive abilities regardless of subject area, the teacher will: A) point out steps for attacking problems prior to any learning activity, B) during any learning activity, the teacher will invite students to share their thought processes, strategies, and problem solving techniques, C) after the learning activity, the teacher will hold a class meeting to reflect upon the activity, evaluate strategies, and plan further strategies as measured by supervisory evaluations, and/or the teacher's journal.

2) Beginning in September of 1993 and extending through January of 1994, the teacher will infuse the Three-Story Intellect model and higher order questioning into the fourth grade curriculum.

3) As a result of developing students' thinking skills, regardless of learning activity, the students will categorize their thinking strategies according to two or more sets of evaluative criteria.

4) To enhance cognitive abilities in students, graphic organizers will be used by the teacher during instruction, and by the students in application activities.

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5) Students will reflect upon learning activities in journals to synthesize thoughts and actions and to translate them into symbolic form.

Proposal Solution Components

The major elements of the approach used to reduce the discrepancy fell into three categories: those strategies designed to infuse thinking skills into the fourth grade curriculum; those strategies designed to empower students with their own thinking approaches; and strategies designed to increase teacher emphasis on teaching for thinking. These elements related to the terminal objective in that they attempted to effect a change in thinking skills of fourth graders to a more sophisticated level. Discrepancy data indicated an inability of students to use higher-ordered thinking skills and probable cause data indicated a lack of teacher focus to infuse higher-ordered thinking skills in the curriculum; an inability of students to conceptualize, analyze, an synthesize; inappropriate curriculum design; and unsuitable assessment procedures.

CHAPTER 4

ACTION PLAN FOR IMPLEMENTING THE SOLUTION STRATEGY

Description of Problem Resolution Activities

The action plan is designed to address three major solution components: development of student cognition and metacognition, instructional changes which address immediate needs and remediate past practices, and instituting appropriate assessment methods.

The phase of the plan addressing the development of student cognition and metacognition will begin in September of 1993. Definitions of thinking in school prior to fourth grade and desired thinking behaviors in fourth grade will be discussed, the first day of the 1993 school year, in a class meeting. Criteria will be established, in that meeting, as to what constitutes thinking and the reflection on one's thinking. The teacher's role in this will be to facilitate the discussions and create an awareness of students' abilities in ownership of their learning. This enhancement of students' thinking skills and ownership

of them will continue throughout the entire school year.

The changes in instruction will begin the first day of the school year of 1993 and continue throughout the school year. The teacher will frequently and deliberately infuse thinking skill strategies in discussions, in the fourth grade curriculum, and in modeling desired behaviors in a variety of school situations.

The institution of appropriate assessment methods phase will ocurr throughout the 1993-1994 school year. Analysis of thinking skill strategies and their transfer across subject lines, and relating problem solving techniques to everyday experiences will be made using authentic assessment vehicles.

The implementation plan is presented below in outline form and in chronological order, allowing for the overlapping of strategies over time.

1. Gather data from parents' and teacher surveys.
   A. Who: Parents will complete a survey for their child, and the teacher will complete a survey for each child.
   B. What: The survey to be used is 'Twelve Ways

Your Child/Student Shows Growth In Thinking Skills." Parents will receive an informational cover letter.

C. When: The survey will be completed in September and again in January.

D. Where: Parents will complete their survey at home and return it to school. The teacher will complete each survey at school.

E. How: The survey can be completed by direct observation and by recalling how a child generally reacts in specific instances.

F. Why: The survey responses help to determine the existence of higher-level thinking.

2. Journal writing by the students will be included as a thinking skill strategy.

A. Who: Each fourth grade student will be responsible for journal entries.

B. What: A compilation of specific thoughts pertaining to cognition and metacognition.

C. When: Journal entries will be made on a daily basis, varying the time of day.

D. How: Students will write their own reactions to learning activities and have availability to respond to Mrs. Potter's Questions and

Barell's Reflective Questions as additional options.

E. Why: Journals will be used to help students take ownership of their own learning and to teach them how to self-assess. They will also be used as a measurement of how each child is increasing in higher-order thinking skills by looking at strategies used by the student, and articulation of thoughts by the student.

3. The students will participate in an audio interview.

A. Who: Each fourth grade student will be interviewed by the teacher.

B. What: Each student will be asked not less than five, nor more than ten thinking questions about their thinking used in a learning activity.

C. When: The interviews will be held during the month of September and again in January.

D. Where: The interview will be held between the student and teacher in an area in the school secluded from other students.

E. How: The teacher will provide a written copy of the interview questions to the student at

the time of the interview. The interview will be conducted orally with the teacher questioning and the student responding. The entire interview will be tape recorded.

F. Why: Comparisons of the two taped interviews will provide a type of measurement to determine use of more sophisticated thinking by the student.

4. The teacher will keep a journal of student observations, thinking skill strategies used, and classroom reflections.

A. Who: The fourth grade teacher will make journal entries.

B. What: The teacher will keep observations of stategies that students use and reflections pertinent to observations of students' thinking behaviors.

C. When: Entries will be added, varying the time each day.

D. How: The teacher will keep an account of student's verbalizations and actions, thinking strategies used in instruction, and feelings about each of those.

E. Why: The journal will enable the teacher to

get a picture of the sequence and scope of the classroom pulse. It serves as documented evidence of what works, and what does not work. It allows a more accurate basis for reflection.

5. Graphic organizers will be used as a developmental tool to promote higher-level thinking.

   A. Who: The teacher and students will use graphic organizers.

   B. What: A host of graphic organizers will be used such as: Venn diagrams, fishbones, ladders, matrixes, KWL, webbing, looks-like sounds-like, and T-charts.

   C. When: Graphic organizers will be introduced in September of 1993 and extend through January of 1994.

   D. How: The teacher will create an awareness of graphic organizers by introducing and modeling graphic organizers across the curriculum. Students will be required to use specific organizers for specific tasks. By January of 1994, students will automatically use organizers to demonstrate concept understanding.

E. Why: Graphic organizers will increase cognitive and metacognitive abilities.

6. The Three-Story Intellect model and hierarchical questioning will be infused into the fourth grade curriculum.

A. Who: The teacher is responsible for implementing this art of questioning.

B. What: The Three-Story Intellect model builds thinking hierarchically. It includes three distinct levels of organizing information: gathering, processing and applying. The text, Questions, Questioning, Questioning Techniques, and Effective Teaching-- William W. Wilen, editor; will be another resource in planning questioning by the teacher.

C. When: The questioning techniques will be initiated in September of 1993 and extend through January of 1994.

D. How: This particular cognitive and metacognitive building strategy will be infused in class discussions, teacher-made tests, and concept developing across the curriculum.

E. Why: This strategy will provide students the opportunity to think at a more spohisticated level.

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Methods of Assessment

A variety of data collection methods will be used in order to assess the effects of this intervention. Evidences of student higher-level thinking will be measured by comparing beginning and ending data on student audio interview responses, thinking journal entries, parent and teacher surveys, and teacher written observations. Abilities to relate and apply facts, reason, conceptualize, analyze, synthesize, and metacognate would be evidenced in those comparisons.

Instructional changes will be documented through formal class observations by the teacher's principal, the teacher's journal entries, and the written record of daily lesson plans.

Chapter 5

EVALUATION OF RESULTS AND PROCESS

Implementation History

The terminal objective of the intervention addressed the inability of the fourth grade students to relate and apply facts and concepts on tasks requiring more sophisticated thinking. Test scores and observations indicated an inability of students to use higher-ordered thinking skills and indicated a lack of teacher focus to infuse higher-ordered thinking skills in the curriculum. Therefore, the terminal objective stated:

> As a result of instructional strategies purposefully intended to develop children's cognitive abilities being integrated into the curriculum, beginning in September of 1993 to January of 1994, the fourth grade students will increase their thinking skill level as measured by survey data which will be administered in September of 1993, and January of 1994, student journal entry comparisons from September of 1993 to January of 1994, teacher written observations from September of 1993 to January of 1994, and student interviews which will be conducted in September of 1993 and January of 1994.

The phase of the plan addressing the development of student cognition and metacognition began at the beginning of the 1993-1994 school year. The teacher, as the facilitator in whole group discussions, initially posed the question, "What is thinking?" Students were given time to contemplate the question, then they shared responses with the whole group. A class concensus resulted in a definition that thinking is saying things in one's head to solve problems. Criteria for effective thinking was established through a series of class discussions over a period of two weeks. The criteria for effective thinking included 1) take time to think before answering any question, 2) create more than one solution to a problem, 3) be open to new ideas and ways of doing things, 4) take risks with thoughts, and 5) use past experiences that may aid in solutions of a new problem.

Implementation of cooperative learning began at the beginning of the 1993-1994 school year. As an instructional strategy, cooperative learning naturally complements the other instructional approaches for developing student thinking skills. Students were given "think time" before the group began a task. Students were instructed to individually think about

how they will approach the task or problem for one minute before group discussion began. Groups were instructed to develop a strategy; to discuss the importance of the content; talk about when, why, and how the information contained in the task is to be used, and identify what is to be learned before beginning a task. Following a cooperative or individual task, students reflected on the processing that occurred while completing the task. The reflections were discussed in cooperative groups, whole class discussions, or their writing journals. Mrs. Potter's Questions (Bellanca and Fogarty, 1989) (Appendix E) and Barell's Reflective Questions (Appendix I) were used to enhance student thoughtfulness in their reflections.

Thinking and reflecting were enriched by the provision of concrete examples and tasks in group activities. For example, groups were provided with materials such as newspaper and paper clips, and instructed to develop a plan for building the tallest tower possible and follow that plan to build that tower. The plan had to be developed within ten minutes and had to preceed the actual building. It was imperative for the students to think before they acted

using this technique. Through teacher modeling and student practice, students were able to "walk through" thinking strategies used in finding problem solutions.

Brainstorming was an instructional strategy that was practiced and used by individuals and cooperative groups. During brainstorming processes, students were encouraged to generate as many ideas as possible about a topic, no matter how outlandish they may have seemed. For example, each cooperative group was instructed to brainstorm as many ways as possible to use a pencil other than that for which it is intended.

A host of graphic organizers were frequently modeled and explained by the teacher to make thinking visable. For example, a Looks Like/Sounds Like T-chart (Appendix J) was explained and used the first week of the 1993-1994 school year to establish good listening rules. A Venn diagram (Appendix K) was explained and used to compare and contrast the Northeastern and Southeastern regions of the United States. Cooperative groups and individuals were assigned specific organizers, depending on the task, to complete and discuss. For instance, students used mind maps (Appendix L) to brainstorm ideas for a creative writing assignment about a given topic and a matrix

(Appendix M) for classifying attributes. By the second quarter of the semester, students were encouraged to use appropriate graphic organizers to organize, reorganize, revise and modify connections as they processed information.

Implementation of productive inquiry by the teacher was addressed by this plan. Using hierarchical questions infused throughout the curriculum, students became accustomed to clarifying and expanding their thinking. Beginning at the start of the 1993-1994 school year, students were given and expected to use 'wait time' after a question was posed. A 'T.N.T.' (Thinking Needs Time) banner graced the wall at the front of the classroom as an encouragement to think before responding.

Presentation and Analysis of Project Results

In order to assess the effects of the planned intervention, a variety of data collection methods were used. Higher-level thinking was evidenced by students thinking journal entries, audio interview responses, parent and teacher surveys, and teacher written observations.

Beginning and ending comparisons of results from student thinking journal entries and audio interviews

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are summarized in Figure 3. Collected data was analyzed for: quality of questions and discussion, relating and applying facts and concepts, reasoning, conceptualization, analyzing, synthesizing, and metacognating.

The utilization of the planned implementation strategies resulted in higher-level thinking responses by the students, hierarchical questions posed by the students, and clarified verbalizations during class discussions by the students. These factors are evidenced by the following excerpts from journal entries and audio interviews:

> "I think doing tangrams is like life, when I grow up because sometimes life will be easy and sometimes life will be hard."
>
> "I solved the things that we were doing because I kept thinking so I kept trying."
>
> "I would do things differently. I would think of more than one answer that would fit before I wrote any answer"
>
> "I put a blank piece of paper in my head and the answer writes itself automatically."
>
> "I solved this by thinking and trying different ways."
>
> "Next time I won't rush through the problem."
>
> "My thoughts showed pictures."
>
> "I will use this thinking strategy in fifth grade."

September - November
* Uses immediate response
* Uses one word answers
* Uses one answer solutions
* Uses rote responses
* Heavy reliance on grade
* Uses creative imagination
* Makes sound predictions
* Classifies limited data
* Conveys several solutions
* Uses elaborated responses
* Clarifies responses
* Defends point of view
* Reflects on pathways of thinking
* Uses 'wait time' before responding
* Verbalizes problem-solving process
* Uses graphic organizers
November - January

Figure 3

Summarized Beginning and Ending Results
of Writing Journal Entries
and Audio Interviews

"Today when I was working on Math, I couldn't get some of the problems, then I remembered that when we got together in our groups that it was easier to figure out."--

"I think when I don't know something because T.N.T. Thinking Needs Time and I think every time I work. That is how I solve everything."

"When I read directions, I read them two or three times. I sometimes don't get them but most of the time I do. My best advice to understanding directions is to keep trying until you get it."

"I think our group got alot done because Jeremy followed along better and was a good thinker. We should do this more and more every quarter. Our group is fun and exciting."

"When I look back over my work I understand what I'm suppose to be learning better."

"I follow directions by reading them over and over. Sometimes I read them once and then I work. Sometimes I ask the person beside me or the teacher. Sometimes I use T.N.T."

"We work great in our group. We talk about our work and we discuss like would this fit here or do you think this is right and why do you think that. We compliment each other alot. We even help each other if we are behind on something. I think groups help me learn more. We have fun."

"The best way to study for me is to first read the questions and then read the pages. When I'm ready to answer the questions, I look back at the subtitles and it is easy to find the answers."

"I did well on telling the people in our group what they were suppose to do."

"We almost needed help, but we worked and talked about it more. If we help each other, we understand better."

"Thinking is what I call dreaming. You can go where ever you want to by just thinking. You can explore Math, Spelling, caves of wonders, Indian life, bird life, and much more. I use thinking to explore everything and anything. I use thinking to explore matters and problems so if I make a choice, it does not hurt anyone else. Thinking is something that I couldn't do without. Sometimes thinking can hurt you; like in a fight, you have to act fast - no time for thinking - but if you would just stop and think you would know that walking away is smarter. That is what I use thinking for."

"Thinking is what I do before I answer a question."

"Thinking is saying things in your head."

"I use thinking with organizers and I use organizers to think!"

"I use graphs to help be think things out."

"Thinking is something you do when you don't know it you have to take time to listen to your thinking."

"Thinking is when you look back through and try to remember if you have ever done anything like this before. If you have, it can help you this time."

"Everybody thinks differently, like in their own words."

A parent survey for each child and a teacher survey for each child was readministered in January of 1994 to compare documented thinking skill levels of the students with the survey from September of 1993. (Appendix C) The summarized January, 1994 parent survey indicated that: six percent of the class are not yet using home thinking skill behaviors indicated on the survey, 35 percent of the class sometimes

demonstrate the home thinking skill behaviors, and 58 percent of the class frequently demonstrate the home thinking skill behaviors. Parent surveys indicated an increase in children's ability to state several ways to solve a problem and a lessened characteristic of impulsive responses and actions. The surveys also expressed a transference of the use of thinking skill strategies from school to home. Students demonstrated graphic organizers to parents, frequently reminded parents that thinking needs time, and often found several solutions to everyday problems. Figure 4 reflects the pre and post parent survey results.

The summarized January, 1994 teacher survey data indicated that: 18 percent of the class are not yet engaging in the thinking behaviors indicated on the survey at school, 31 percent sometimes show school thinking behaviors, and 52 percent frequently exhibit the behaviors on the survey. The increase of students frequently using thinking skill behaviors in the classroom is dramatic. A major component of this plan has been to utilize instructional strategies to foster more sophisticated thinking skills. Over half of the students in this class have been successful in applying the strategies on a regular basis. Most students are

able to perserverе when faced with a problem. Students rely on prior knowledge when confronted with a new concept, and can verbalize the process. Students incessantly take more time to respond to a question. Looking back upon completion of a problem is not yet addressed by the majority of the students in the class. Also, most of the students have difficulty explaining how a problem-solving process can be used in their everyday life. Figure 5 depicts the pre and post teacher survey results.

The discrepancy factors discussed in chapter two, in regard to Figure 2, pertain to the variance in the parent and teacher survey results of Figures 4 and 5. Objectivity, relationship, and expectation of the child are facets in each parent response and in teacher response. Figures 4 and 5 reflect the complied data.

Reflections and Conclusions

The implementation of this plan accelerated the thinking skills of the fourth grade students beyond simple recall, recite, and describe. The students clearly increased in knowledge of how to facilitate thinking.

Through instructional strategies addressed in this plan, student abilities were stretched and

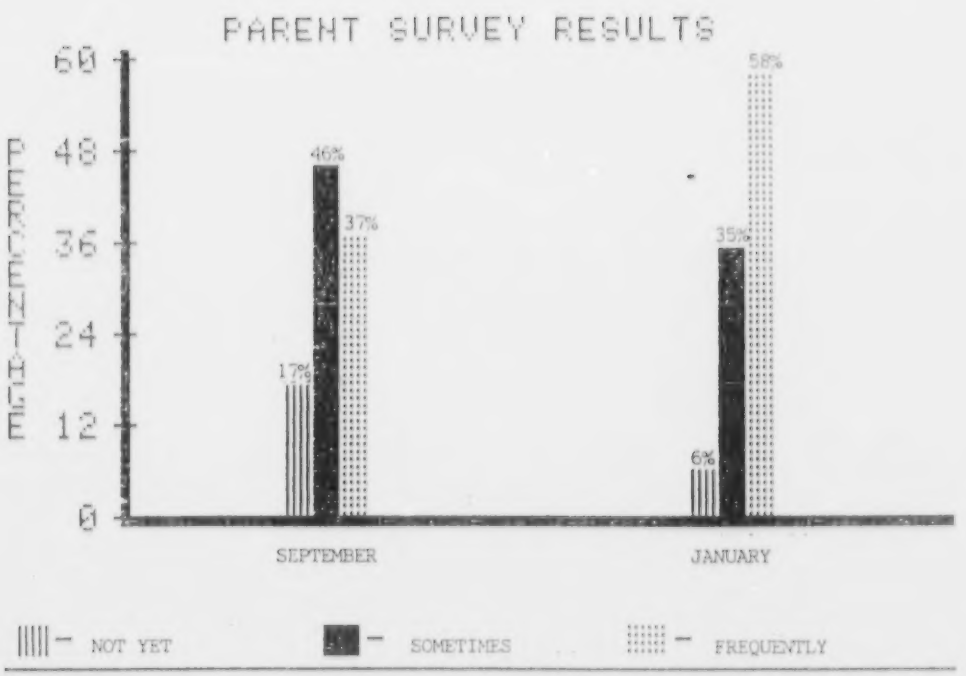

Figure 4

Percentage of Children Engaging in Thinking Skill Behaviors,
Pre and Post Parent Survey Results,
September 1993 and January 1994

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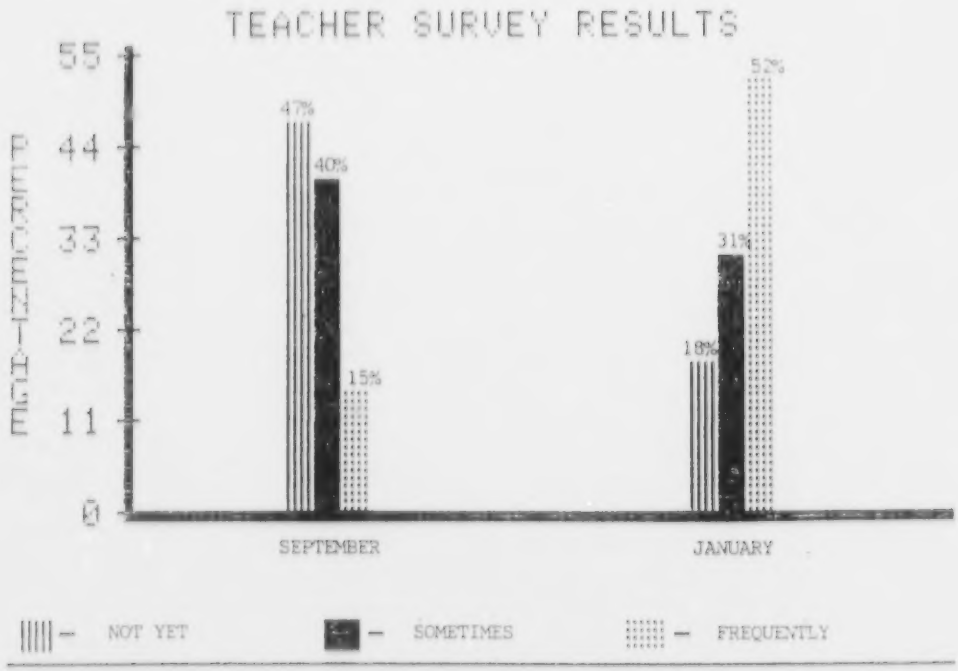

Figure 5

Percentage of Children Engaging in Thinking Skill Behaviors,
Pre and Post Teacher Survey Results,
September 1993 and January 1994

strengthened. Assessment data revealed student competence to self-assess, exhibit ownership of learning, and articulate thoughts. Students demonstrated appropriate use of graphic organizers to increase cognitive and metacognitive proficiency. The deliberate design of the implementation proved effective in student use of hierarchical questioning including gathering, processing, and applying. This plan provided a firm foundation for students to engage more skillfully in ordinary types of thinking. The impact on the students is immediate and crucial to future learning.

Chapter 6

DECISIONS ON THE FUTURE

The Solution Strategy

The data indicate that the program for enhancing the thinking skills of fourth grade students should be continued. For these students, meaningful differences were observed during the implementation from September of 1993 to January of 1994. Students, over the course of the implementation were more willing to perservere when problem-solving. Qualitative verbalization about aspects of the problem, possible strategies, and justification of solutions were observed frequently. From teacher observations and teacher journal entries, students were more open to alternative strategies and received more corrective feedback from peers. Students also attempted to use a learned strategy more readily when tackling a new problem. This plan takes the focus away from the teacher as the answer person and problem solver and places it on the student.

Additional Applications

In spite of the availability of models for teaching higher-level thinking skills, the National Assessment of Educational Progress (NAEP) results continue to show that most 9, 13, and 17 year-old students do relatively poor on questions requiring more sophisticated thinking (Kouba, Brown, Lindquist, Silver, and Swafford, 1988). There has been little change or progress in this area of achievement over the last decade or so.

Research has concluded that higher-level thinking skill strategies can be taught to teachers and learned by students. There is a large difference, however, between potential and reality. Perhaps many of the models and techniques demand a higher degree of understanding of the thinking process than most teachers have had the opportunity to experience through advanced training. Maybe the major contributor to students' inability to use more sophisticated thinking is the over emphasis on memorization of information. Possibly the students perception that learning is highly competitive, with rewards going to those that have the correct answer in the fastest way, contributes to their unwillingness to take the time to learn

processes that can be used over and over in solving problems. All of these factors can be mitigated through the informed use of thinking skill-building throughout a curriculum.

Dissemination of Data and Recommendations

Qualifying today's youth for tomorrow's world is a tremendous task. Careers of the future available to today's student have yet to be invented. It is imperative to facilitate the student of today to be comprehensively ready for tomorrow's world. Efforts should be undertaken to establish relavance to building more sophisticated thinking so more variables can be encompassed in decision making. When an individual can study an already used processing strategy in conquering new conceptualizations, then a fresh proposition can be built. The crucial component of the data from this implementation plan calls for continual development of teachers - staff development. To enhance student thinking, teachers need provided opportunities to practice and discuss instructional strategies, observe modeled instruction, and engage in higher-order thinking such as authentic problem solving in their subject areas. Teaching for thinking is the critical element for educating today's student for tomorrow's world.

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APPENDICES

Appendix A

Dear Principal,

In researching the importance of enhancing thinking skills of students to a more sophisticated level, I have concluded that one probable cause may be instructional exclusion of emphasis on and development of problem solving, reasoning, conceptualization, and analysis. Most standard curriculum lends itself to the basic thinking skills of recall, recite, and describe.

Through direct and written observations of the faculty, I would like you to tally the number of faculty who, the majority of the time:

_____ A) Ask questions that demand 'why' and 'how' responses. Infuse higher level thinking questions into class discussions, teacher made tests, and concept developing across the curriculum.

_____ B) Identify and label specific strategies used in solving problems. For example, Venn diagrams, Fishbones, Ladders, Matrixes, KWL, Webbing, and T-charts.

_____ C) Reflects with students explicitly on the cognitive processes used to solve a problem. Uses 'looking back' and self-assessment regularly.

_____ D) In the context of regular subject matter, reminds students of cognitive strategies which can be applied.

_____ E) Creates a classroom climate for thinking by using an acceptant tone during discussions.

_____ Total number of faculty members.

Please keep in mind, this is not a reflection upon this particular school or faculty. My research into this area reveals that a national problem exists and is being addressed not only by educators, but by society itself in seeking to qualify today's youth for tomorrow's world.

Thank you for your time and cooperation.

Pamela Wade

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Appendix B

A Thinking Skills Checklist

Barry K. Beyer

	Yes	*In Progress*	*No*
1. Does your school system have:			
a. A list of major thinking skills to be taught throughout the system?	_____	_____	_____
b. Agreement among all subject areas that these skills should be taught throughout the system?	_____	_____	_____
c. A K-12 curriculum document that clearly delimits which thinking skills are to be taught at each grade level in each subject area?	_____	_____	_____
d. A K-12 curriculum document that presents thinking skills to be taught in a developmental sequence based on the cognitive development of learners, nature of the target skills, and subject-matter needs?	_____	_____	_____
e. A thinking skills curriculum that provides for continuing instruction in these thinking skills across many grade levels and subjects?	_____	_____	_____
f. Detailed descriptions of the operating procedures, rules, and distinguishing criteria of each major thinking skill or process to be taught?	_____	_____	_____
g. Appropriate thinking skill descriptions in the immediate possession of every teacher and administrator?	_____	_____	_____
h. Provisions for instruction in each skill with a variety of media, in a variety of settings, and for a variety of goals?	_____	_____	_____

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	Yes	In Progress	No
2. *Do your teachers:*			
a. Use a common terminology and instructional language to describe the thinking skills they are required to teach?	_____	_____	_____
b. Provide instruction in thinking skills when these skills are needed to accomplish subject-matter learning goals?	_____	_____	_____
c. Understand the major components of the thinking skills they are teaching?	_____	_____	_____
d. Provide continuing instruction in each thinking skill through the stages of readiness, introduction, guided practice, extension, practice, and application?	_____	_____	_____
e. Introduce thinking skills as explicitly as possible by explaining and modeling each skill and having students apply the skill with their guidance?	_____	_____	_____
f. Provide frequent, guided practice in each skill with appropriate instructive feedback?	_____	_____	_____
g. Require students to reflect on and discuss how they make each skill operational?	_____	_____	_____
h. Use instructional materials appropriate to learning thinking skills?	_____	_____	_____
i. Test on their own unit tests the thinking skills they are responsible for teaching?	_____	_____	_____
3. *Do your provisions for evaluating the learning of thinking skills include the:*			
a. Selection or development of instruments that measure student performance on skills taught in the school system?	_____	_____	_____
b. Use of instruments that are valid measures of thinking skill competency?	_____	_____	_____
c. Use of instruments that provide the maximum data for diagnostic or monitoring purposes?			
4. *Do your supervisors and instructional leaders:*			
a. Understand the nature of the thinking skills and how to teach and measure them?	_____	_____	_____
b. Provide inservice instruction in the nature of the thinking skills to be taught and in different ways to teach these skills?	_____	_____	_____
c. Help teachers in different subject areas and grade levels share methods for teaching thinking skills?	_____	_____	_____

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	Yes	*In Progress*	*No*
d. Ensure that teachers follow the thinking skills curriculum?	_____	_____	_____
e. Ensure the revision of the thinking skills curriculum, instructional strategies, and instructional materials as appropriate?	_____	_____	_____

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Appendix C

TWELVE WAYS YOUR CHILD SHOWS GROWTH IN THINKING SKILLS

This is a parent tool for rating a student's home thinking behaviors at the beginning of the school year.

* Mark each behavior using: N-Not Yet S-Sometimes F-Frequently

* Give an example for each behavior marked 'Sometimes' or 'Frequently'

Your child's name_____Age_____

_____ 1. Keeps on trying; does not give up easily.
EXAMPLE:

_____ 2. Is not impulsive: thinks before answering a question.
EXAMPLE:

_____ 3. Listens to others with understanding.
EXAMPLE:

_____ 4. States several ways to solve a problem.
EXAMPLE:

_____ 5. Puts into words how he/she solved a problem.
EXAMPLE:

_____6. Checks completed work without being asked.
EXAMPLE:

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_____ 7. Asks questions: wants to find out new information.
EXAMPLE:

_____ 8. Uses knowledge, already learned, in new situations; can solve problems in everyday living (using allowance, taking messages, going to the store, and practicing safety.
EXAMPLE:

_____ 9. Uses words carefully to describe feelings, and wants.
EXAMPLE:

_____ 10. Uses touch, feel, taste, smell, sound, and sight to learn.
EXAMPLE:

_____ 11. Enjoys making and doing original things; likes to show individuality in thought and dress.
EXAMPLE:

_____ 12. Enjoys problem-solving; wonderment, inquisitiveness, and curiousity.
EXAMPLE:

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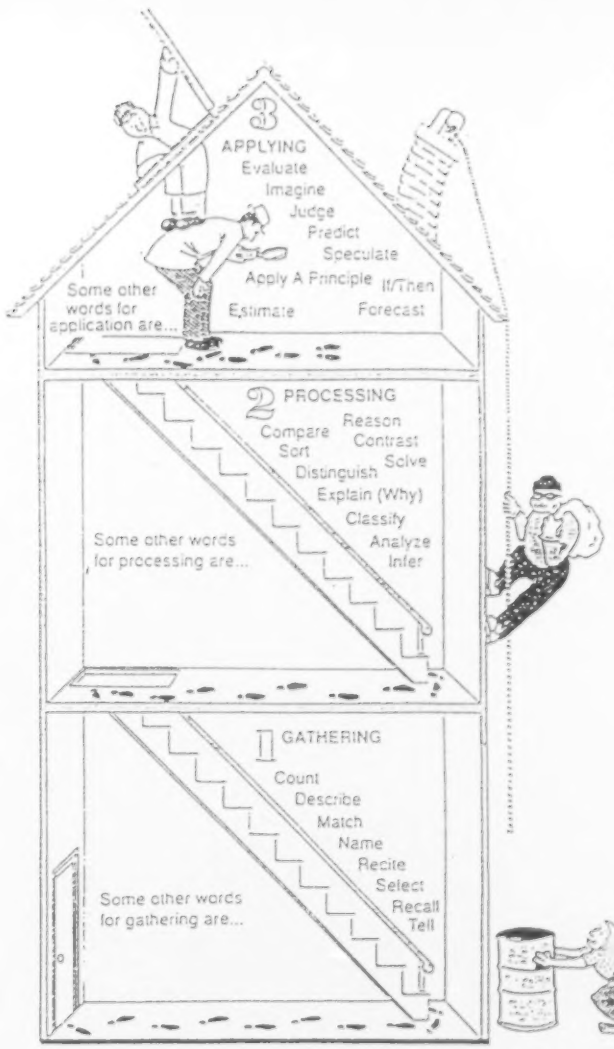
THE THREE-STORY INTELLECT



There are one-story intellects, two-story intellects and three-story intellects with skylights. All fact collectors who have no aim beyond their facts are one-story men. Two-story men compare, reason, generalize, using the labor of fact collectors as their own. Three-story men idealize, imagine, predict—their best illumination comes from above the skylight.

— Oliver Wendell Holmes

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Mrs. Potter's Questions

1. What were you supposed to do?
2. What did you do well?
3. What would you do differently next time?
4. Do you need any help?

HOW ARE WE DOING?

ATTRIBUTE: LISTENING TO OTHERS— With understanding and empathy

OBSERVABLE INDICATORS	OFTEN	SOMETIMES	NOT YET
Maintains eye contact			
Pays attention			
Paraphrases others' responses			
Demonstrates body language (e.g., nods approval, sits up, etc.)			
Asks questions related to the topic			
Responds by actions or words			
Gives accepting responses (the way in which the responses are given)			

Source: Bena Kallick, Westport, Conn.

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HOW ARE WE DOING?

ATTRIBUTE: OVERCOMING IMPULSIVITY—Deliberativeness

OBSERVABLE INDICATORS	OFTEN	SOMETIMES	NOT YET
Listens to directions before starting			
Listens to responses of others and does not repeat what has been said or asked			
Asks questions to clarify the task or direction			
Decreases number of erasures			
Reduces the number of unnecessary, repetitious questions			
Analyzes the problem and develops a plan (uses visual strategies—e.g., mind map)			
Thinks before answering			
Takes time to use thoughtful, precise language			
Can paraphrase when called upon			

Source: Bena Kallick, Westport, Conn.

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HOW ARE WE DOING?

ATTRIBUTE: PERSISTENCE—Persevering when the solution to a problem is not immediately apparent.

OBSERVABLE INDICATORS	OFTEN	SOMETIMES	NOT YET
Stays on task			
Seeks alternative sources of data			
May take a break, but returns to task			
May say, "Don't tell me, let me figure it out!"			
Shows intenseness of thought			
Says, "Wait a minute, I want to finish!"			
Completes task or project			

Source: Bena Kallick, Westport, Conn.

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HOW ARE WE DOING?

ATTRIBUTE: FLEXIBILITY IN THINKING

OBSERVABLE INDICATORS	OFTEN	SOMETIMES	NOT YET
Is willing to change her/his mind			
Accepts another point of view ("I agree . . ." "I understand . . ." "I see and . . . ."			
Accepts or offers more than one alternative/idea to the problem			
Is able to change focus without panic or fretting			
Is able to compromise (gives up "ownership" or role)			
Is willing to consider more than one thing or source at a time			
Is willing to accept that there may not be an answer			

Source: Bena Kallick, Westport, Conn.

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Appendix G

Twelve Ways Your Child/Student Shows Growth in Thinking Skills

This is a parent/teacher tool for rating a student's home/school thinking behaviors at the beginning and end of a school year. It should identify student strengths and weaknesses and promote some parent/teacher "team" goal setting to help the student develop more successful thinking strategies.

Mark each behavior using: N-Not Yet S-Sometimes F-Frequently

During the _____ school year I notice that Name: _____

_____ Age: _____ does the following:

Parent	Teacher	
		1. Keeps on trying; does not give up easily.
		2. Shows less impulsivity; thinks more before answering a question.
		3. Listens to others with understanding and empathy.
		4. States several ways to solve a problem. (shows flexibility in thinking)
		5. Puts into words how he/she solved a problem; is aware of his/her own thinking.
		6. Checks for accuracy and precision; checks completed work without being asked.
		7. Asks questions; wants to find out new information.
		8. Uses knowledge already learned in new situations; can solve problems in everyday living like using allowance, taking messages, going to the store, and practicing safety.
		9. Uses words more carefully to describe feelings, wants, other things.
		10. Uses touch, feel, taste, smell, sound, and sight to learn; enjoys art, music, experimenting, and active play.
		11. Enjoys making and doing original things; likes to show individuality in thought and dress.
		12. Enjoys problem solving; wonderment, inquisitiveness, and curiosity.

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Appendix H

Thinking Skills Program Parent Feedback

Dear Parent,

As you are probably aware, your child is participating in a thinking skills program in school this year.

To better understand the effects of the program, it would help us if you could complete this brief feedback form. In the questions below and on the back of this sheet, please check the appropriate box and make any comments you can.

Thank you for your cooperation.

Name: _____

_____

Student's Name: _____

1. My child talks to me about the thinking program:

   ☐ frequently ☐ occasionally ☐ never

   Comments: _____

   _____

   _____

2. My child uses terms like Questions, Impulsivity, Metacognition, Persistence/Perseverance, Compare/Contrast, Inference/Assumption, Data/Opinion, at home:

   ☐ frequently ☐ occasionally ☐ never

   Comments: _____

   _____

   _____

3. I work with my child at home on problems that require thinking:

   ☐ frequently ☐ occasionally ☐ never

   Examples: _____

   _____

   _____

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4. My child uses skills learned in the thinking program, to my knowledge:

☐ frequently ☐ occasionally ☐ never

Comments: _____

_____

_____

5. Below please record any changes you have noticed in your child's thinking as a result of doing the thinking skills program at school.

_____

_____

_____

_____

_____

_____

_____

_____

This year I will help _____ develop

skills in: _____

by: _____

_____

_____

Signed: _____ (Parent)

This year I will help _____ develop

skills in: _____

by: _____

_____

_____

Signed: _____ (Teacher)

Date: _____ Review Date: _____

Source: Charlotte Palmer, Pinellas Park Elementary School, Pinellas Park, Fla.

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Some General Things Parents and Teachers Can Do to Encourage Thinking

1. Have faith that all children can think. They need to see thinking as a goal.
2. Share with children how you solve different kinds of everyday problems.
3. Provide opportunities for challenging problem solving.
4. Create a safe, risk-taking environment. It is OK to make mistakes; we can learn from them.
5. Give thinking time. We all develop at our own rate—physically, mentally, emotionally, and socially.
6. Model lifelong learning; be aware of your own growth and enjoyment of learning. (You don't lose the car keys anymore!) Get excited about life. Make each day count.

Some Suggestions for Strengthening Each of the 12 Thinking Skills

1. Persistence: "If at first you don't succeed, try, try again." Make it fun and OK to try again. Play "Clue" or read "Choose Your Own Adventure" or solve-it-yourself mystery books. Do experiments or plant a little garden for fun.

2. Decreasing impulsivity: Build models or work connect-the-dots puzzles, word searches, and crossword puzzles. Make your own mazes. Play video games, "Operation," "Perfection," or pickup sticks. Look for experiences that demonstrate "haste makes waste."

3. Listening to others: Play charades or telephone. Analyze characters' feelings in comic strips, television programs, and stories read and listened to. Hold a funeral for put-downs or zingers: Write them down, put them in a box, and bury them.

4. Flexibility in thinking: Try group problem solving and team tasks. Compare notes on how you do routine tasks like tying bows, mowing the lawn, drying dishes, or cleaning your room and how you do fun things like playing a video game, shooting a basket, or catching a pop fly. Try your child's way of doing a task and encourage him or her to try yours.

5. Awareness of our own thinking: Play checkers, chess, or some other strategy game and describe to an observer why you make each of your own moves. Have your opponent do the same. Challenge children to give a step-by-step explanation of how they make something, then guess what the outcome will be.

6. Checking for accuracy and precision: Play "I doubt it." Challenge children to show you how they can be sure something is true. Encourage them to challenge you in polite ways.

7. Questioning and problem solving: Ask children, "Have you asked any good questions today?" When questions are asked, help children locate the answers. Tell them why you chose a particular source of information to get an answer. Play "Question Me an Answer." Give a fact—your answer—then challenge students to ask different questions your fact would answer.

8. Drawing on past knowledge and applying it to new situations: Encourage involvement in scouting programs, church youth groups, boys' and girls' clubs, 4-H, and so on, where children take part in supervised group projects that raise money, help others, and take them on field trips. Play games like "Life," "The Allowance Game," "Monopoly," and so on. Give limited responsibility for running errands, taking messages, caring for animals, and the like.

9. Precision of language and thought: Play describing games; compare ads; explain why you use a particular cereal, soap, or toothpaste. Introduce *Consumer Reports* guides. Show how they compare products so you can decide what is the best value for your money.

10. Using all the senses: Play tasting, smelling, feeling, and sound location games. Draw pictures to music. Encourage field trips, "hands-on" experiments in class, cooking, model building, sewing, and carpentry at home. Do role-playing; put on plays. Play "Jr. Pictionary" or "Win, Lose, or Draw."

11. Ingenuity, originality, insightfulness, creativity: Try dressing up or lip-synching for fun. Do some scrap art or junk puppets. Watch "Pee Wee's Playhouse," the "California Raisins," or "Fraggle Rock" together. Create a diorama or make your own holiday decorations. Find a new use for familiar items.

12. Wonderment, inquisitiveness, curiosity, and the enjoyment of problem solving: Visit Great Explorations, MOSI, or EPCOT Center. Watch a 3-D movie. Learn a new skill together. Play "What would happen if . . ." (e.g., What would happen if . . . everybody were active all night and slept during the day? . . . we all lived underwater? . . . animals could talk?) Brainstorm together.

Don't limit yourself to these suggestions. Use them to stimulate your own thinking, and come up with your own ideas for using each of the 12 thinking skills. You know your child or student and know how best to motivate his or her interest and inspiration. Have fun together. Encourage a sense of humor.

Source: Charlotte Palmer, Pinellas Park Elementary School, Pinellas Park, Fla.

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Appendix I

BARELL'S REFLECTIVE QUESTIONS

"How did you figure that out?"

"Where else have your used or can you use such a strategy?"

"How did you solve it?"

"What made you ask that?"

"What relationships or connections can you see between this concept or idea and anything else you know about?"

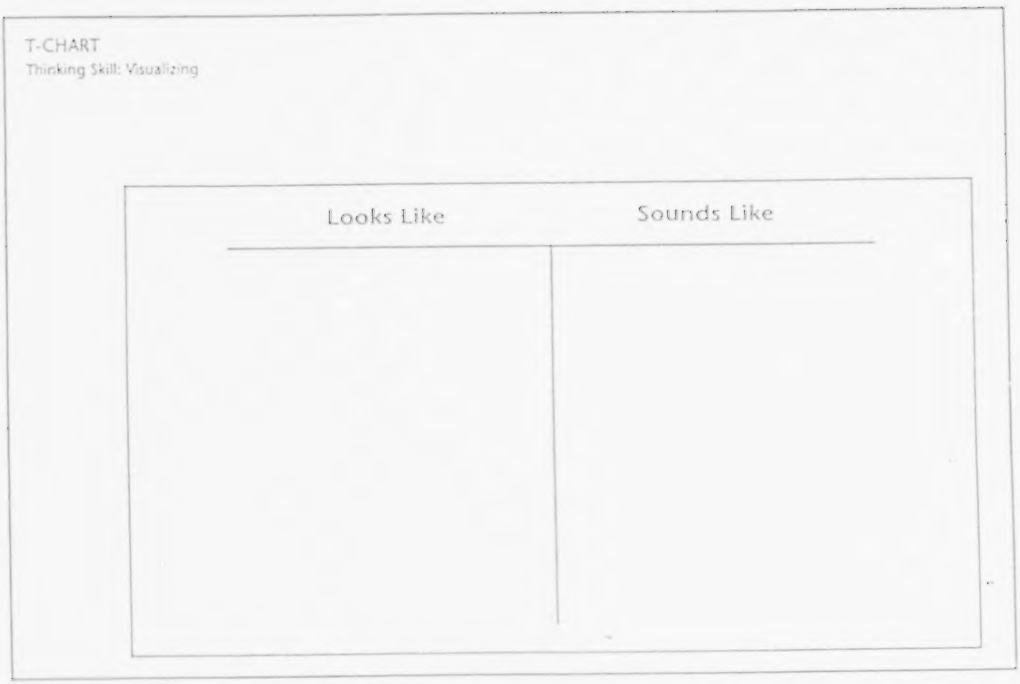
"What did you learn about your thinking?"

"What have you learned about yourself, your thinking, about working with others?"

"What do I know already? What do I need to know? How might I proceed?"

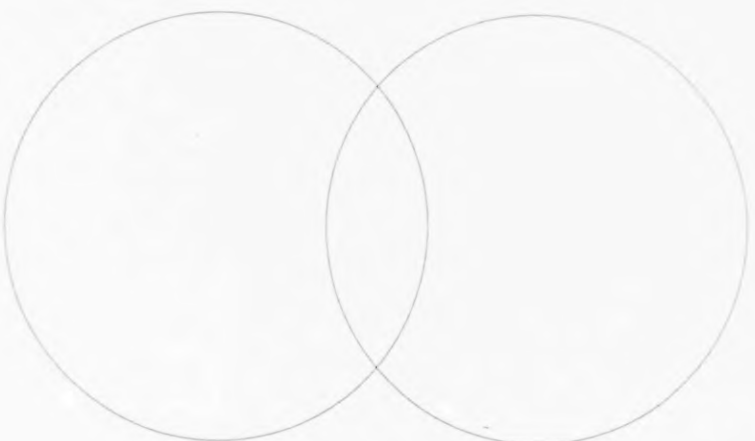
"When you wanted to get XXXX, what did you do?"

Appendix J

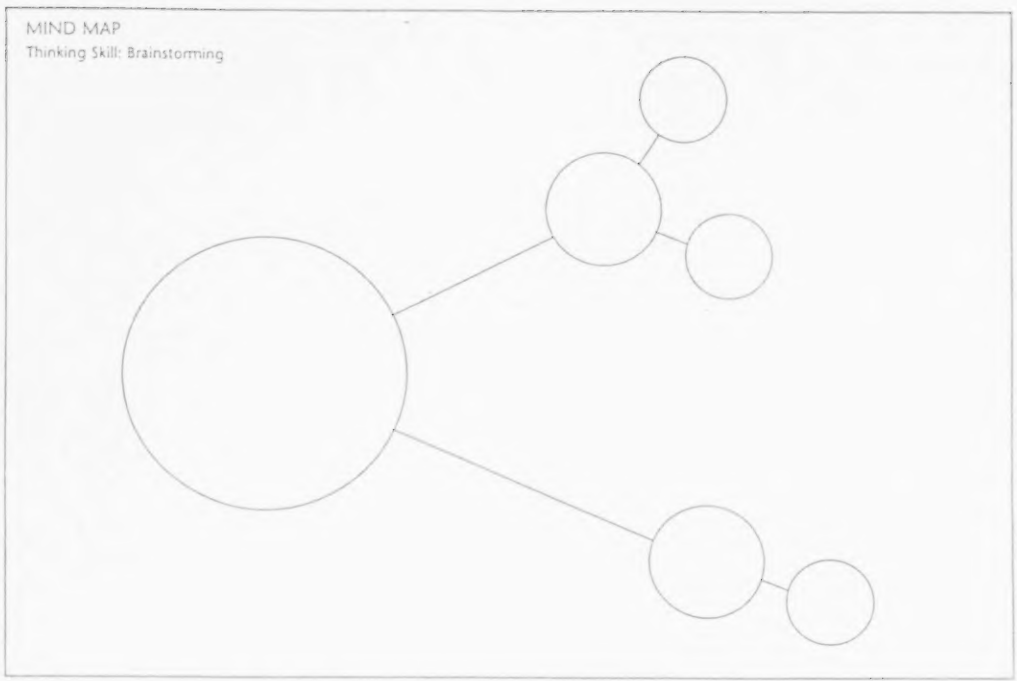


Appendix K

VENN Diagram
Thinking Skill: Comparing & Contrasting



Appendix L



Appendix M

MATRIX
Thinking Skill: Classifying

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